The causal link between benchmark crude oil and the U.S. Dollar Value: in rising and falling oil markets

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Abstract— **This paper researches the link between benchmark crude oil prices and the U.S. dollar exchange rate, in rising, stable and falling oil markets. The methods used to explore the relationship in various markets were cointegration testing and Granger causality tests. The method allows the author to analyse the link in the short run and long run. The results found that in the long run a relationship does exist between oil prices and U.S. dollar exchange rate in stable markets. In rising and falling markets there is no long run relationship. The study did find evidence of a short relationship in rising, stable and falling oil markets.**

Keywords—oil price, U.S. dollar, Granger causality, cointegration

1. INTRODUCTION

The topic of oil price formation is becoming increasingly complex in the current global market. The numbers of variables attributing to global oil prices are extensive and range from OPEC (Organization of Petroleum Exporting Countries) policy changes, to economic cycles and the U.S dollar exchange rate. The variables that impact oil prices are ever changing and their relevance at various points in time will also change. For example, in an economic recession demand figures may hold more importance than supply figures, in a boom it may be reversed. Also certain variables may hold more importance at different time frequencies. For example, some variables such as economic activity indicators may have a long-term impact, where as a supply shortage may have a short-term impact.

Oil prices often experience rising trends, falling trends and stable trends, where prices 'bounce' between a range (high and a low price). Prices may rise when the oil demand is greater than oil supply. This may happen when economies are growing leading to high levels of oil demand or when supply is short due to events such as geopolitical conflicts in oil producing or oil transit nations. Prices may fall when supply significantly outstrips demand. This may happen due to an increase in supply due to new and vast discoveries, falls in demand due to a decline in global economic activity or a suitable alternative to oil products becoming available.

One of the key variables for oil markets is the U.S. dollar exchange rate, as crude oil transactions are predominately completed in U.S. dollars. Poor understanding of this relationship can lead to poor decision making by businesses and governments. An example of this may be if changes in the U.S. dollar exchange rates impact crude oil prices, any policies released by the US Federal Reserve that impact the U.S. dollar might impact global crude oil prices.

The overall consensus of the academic literature to date is that there is a negative correlation between the U.S. dollar value and benchmark crudes such as West Texas Intermediary (WTI) and Brent North Sea (BRE) (Lizardo and Mollick, 2009). Research has now progressed and econometric analysis is being utilized to further assess this relationship. It is widely evidenced that there is a relationship between the two variables (oil price and U.S. dollar), however there are mixed views on how changes in global oil prices impact changes in US exchange rates or vice versa. Brahmasrene, Huang and Sissoko (2014) described the oil prices and exchange rate dynamic as inconclusive. The literature tests the relationship with a variety of methods however the outcomes tend to be mixed.

Huang and Tseng (2010) detect a significant two-way causal relationship between oil price disturbance and the U.S. dollar exchange rate, over a 20-year period. Ding and Vo (2012) used a multivariate stochastic volatility and a GARCH model to investigate volatility interactions between oil prices and exchange rates and found that during calm market times, both variables reacted simultaneously. However in turbulent times, a shock in one variable will impact the other variables at a later date. Uddin et al. (2013) found that exchange rate changes affect oil prices in the short run. Brahmasrene, Huang and Sissoko (2014) finds that, in the short run, changes in the exchanges rates' Granger causes changes in crude oil prices and in the long run changes in the oil prices' Granger causes changes in exchange rates. On the other hand Basher el al. (2012) finds that oil price shocks tend to depress U.S. dollar exchange rates in the short run. Lizardo and Mollick, (2009) find in a long run forecast that increases in oil prices lead to a depression of the US exchange rate against net oil exporter currencies. Chen and Chen (2007) found that in the long run changes in oil prices cause changes in exchange rates. Reboredo and Rivera_castro (2013) used a wavelet approach and found that oil prices led exchange rates at negative dependence in crisis period. Mensi, Hammoudeh, Yoon

(2015) uses a bivariate GARCH model to test asymmetric volatility and finds a significant asymmetry between U.S. dollar exchange rate and petroleum markets, but does not suggest a direction. Benhman (2012) uses wavelet and Granger causality testing and found causality changes depending on time frequency. For a three-month period changes in oil prices cause changes in U.S. dollar exchanges rates for post 16 months there is a bidirectional relationship.

The current literature investigates the relationship in a variety of ways, however little research has been conducted on assessing the relationship dynamics in various oil price trends. This paper sets out to explore the relationship between benchmark crude oil prices and the U.S. dollar exchange rate in periods of rising, stable and falling oil prices. This topic is important in adding to understanding the depth of the relationship between oil prices and the U.S. dollar. For oil importers or oil exporters, the value of the U.S. dollar can have a positive or negative influence on our domestic and global economies (Nazlioglu and Soytas, 2011).

The overarching aim of this paper is to investigate and assess the causal relationship between oil prices and U.S. dollar exchange rates, in rising, stable and falling oil markets. It is important to note the number of variables that impact the global oil price are vast, this study is concentrating on empirical analysis of one relationship however in reality there are more factors that come into play. The research will utilise cointegration and Granger causality testing to address the aim.

2. METHODOLOGY

2.1 DATA SOURCES AND DESCRIPTION

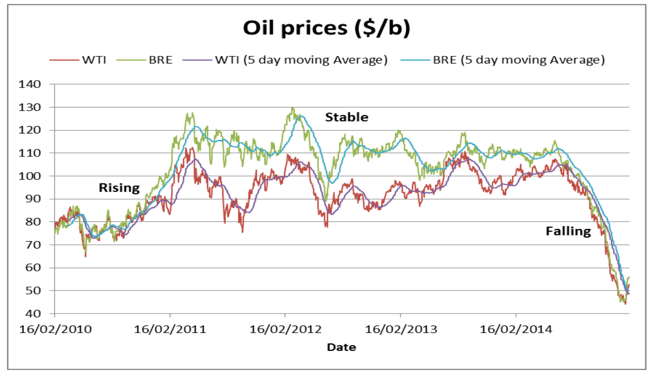
This paper has adopted an econometric framework for analysing the data for U.S. dollar exchange rate verses sterling (*USD*), West Texas Intermediary prices (*WTI*) and Brent Crude (*BRE*) Oil Prices. Brent and WTI were used over other crudes, as they are the global oil benchmarks. Data has been sourced from Thompson Reuters with a daily time series from January 2010 until January 2015. The three variables are represented in the USD as *(USDt)*, WTI as *(WTIt)*, and BRE as *(BREt).*

The purpose of this research is to assess the relationship between the two variables in various markets. Lunde and Timmermann (2000) stressed that there is no generally accepted formal definition of up and down markets in finance literature. Therefore the time series will be organised into three key categories: Rising oil markets, stable oil markets and falling oil markets. Brent prices were used as the leader for categorising the time series.

Category 1 - Rising Markets: In this data set Brent prices peaked at $124.28 per barrel and the trough is $66.94 per barrel, resulting in a data range of $57.34. There were 283 observations in the sample.

Category 2 – Stable markets: During this time period Brent prices fluctuated between a price of $88.95 and $127.29, with a range of $38.34. As viewed in figure 1, the Brent price fluctuated in between this range rather than following any particular trend. There were 700 observations in the sample. The WTI price did experience more volatility, which was attributed to supply gluts in the WTI market and consequently causing a divergence from Brent crude.

Category 3 – Falling markets: In this sample Brent prices fell from a $115.59 to $45.08, with a range of $70.51. There were 250 observations in the sample.



(Figure 1: author's compilation)

2.2 UNIT ROOT TEST

If time series data is used it is a necessary step to check the presence of unit root and determine the order of integration of the series. If a series is stationary (no unit root), its mean, variance and auto-covariance are not a function of time. The test used to check for a unit root within the series is an Augmented Dickey-Fuller (ADF). Nelson and Plosser (1982) pointed out that most of the macro time series are non-stationary (with unit root). If the data is non-stationary, the first differences are generated until the data becomes stationary and are then used in the analysis.

The Augmented Dickey-Fuller (ADF) is the most common method used that tests existence of non-stationary time series data. For this test the null hypothesis claims there is a unit root $\gamma = 0$ (non-stationary) whereas the alternative hypothesis states the series is stationary (without unit root) if $\gamma < 0$. If the data is non – stationary, the first differences are tested, if the first differences are stationary the data series is said to be *I (1),* integrated of the order one**.**

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum \alpha_i \Delta Y_{t-1} + e_{1t} \quad (1)$$

Y_t, represents a time series and Δ represents the first difference and e_{1t} represents the residual.

2.3 JOHANSEN COINTEGRATION TEST

Engle and Granger (1987) stated two or more non-stationary series could be cointegrated and become stationary, while as individual series they are non-stationary. If two linear combinations are stationary, the two series are cointegrated (a long run equilibrium relationship exists).

The Johansen test is used to test the cointegration between the two series (Johansen 1988). The Johansen test is a joint test, testing the number of co-integrating vectors in a model. In this case we are using variable pairs and therefore testing if one cointegrating relationship exists or not. The statistics used to measure this are the trace likelihood test and maximum eigenvalues' likelihood test. Johansen cointegration test examines the long run relationship amongst oil prices and U.S. dollar exchange rates, for all three categories. If the series are cointegrated they have similar stochastic trend and therefore the two series have a long run relationship.

2.4 GRANGER CAUSALITY TEST

While the Johansen tests, measures for long run cointegration among variables, it does not measure the short relationship or the direction of the relationship. This paper will employ Granger causality tests to better understand the relationship between oil price and U.S. dollar value. The Granger causality tests do not simply test if one variable causes a change in another variable. Granger causality tests if variable *Y* can be better forecast or predicted by past values of variable *X* and *Y*, rather than just y Granger (1969).

The relationship between two variables could be in a single direction or bi- directional. An F test using vector auto regressive models (VAR) have been used to test Granger causality. The bivariate VAR model utilised looks at forecasting a variable (*OP*) by using two past values of *OP* and *USD* and vice versa. The below equations set out the bivariate VAR Models:

$$OP_t = \alpha_1 + \sum \alpha_i OP_{t-1} + \sum \beta_j USD_{t-j} + e_{1t}$$
$$USD_t = \alpha_1 + \sum \alpha_i USD_{t-1} + \sum \beta_j OP_{t-j} + e_{1t}$$

(2)

Where, *USD* is the U.S. dollar exchange rate, *OP* is the Oil Price (relates to *BRE* or *WTI*) and
e_{1t} is the error term.

Before testing for causality, we already know the order of integration and the cointegration (long run relationship) of the paired variables. If the two series are not cointegrated in the long run they may still have a short run relationship. In this case Granger causality is still tested between variables by using a standard vector auto regressive on the first differences of the variable. An F-test is used to jointly test for the significance of the lags on the explanatory variables; this in effect tests for 'Granger causality' between two variables. The above model can only be used on individually stationary series and no cointegration between the two variables. If the series do have a unit root, we can test this model on using the first differences to test the short run relationship.

If the two series are cointegrated, an error correction model can be constructed to assess the short run relationship. The model will test the short run relationship of the VAR model into its long run one by including an error correction term as an additional regressor.

If, *BRE* and *USD* are cointegrated, the first difference of these variables will be added into the VAR model, and augmented. The single equation ECM can be represented as below:

$$\Delta USD_t = \alpha_1 + \beta_1 \Delta OP_{t-1} - \sigma_1 (USD_{t-1} - \delta OP_{t-1}) + e_{1t}$$

can be expressed as:

$$\Delta USD_t = \alpha_1 + \beta_1 \Delta OP_{t-1} + \sigma_1 USD_{t-1} - \delta OP_{t-1} + e_{1t}$$

or/

$$\Delta USD_t = \alpha_1 + \beta_1 \Delta OP_{t-1} - \sigma_1 ECM_{t-1} + e_{1t}$$

(3)

Where, β_1 estimates the short effects of an increased *OP* on *USD*, σ_1 estimate's the speed of return to equilibrium after a deviation and δ estimate's the long run effect that one unit increase in *OP* has on *USD*.

3. EMPIRICAL RESULT

3.1 UNIT ROOT TESTS

Firstly we check the order of integration of all three variables individually, for each category by employing an Augmented Dickey Fuller (ADF) test. The hypothesis is:

H_0: The data series is non-stationary (unit root)
H_1: The data series is stationary (no unit root)

Null Hypothesis	***USD***	***BRE***	***WTI***
Rising Markets			
Test Statistic [prob.]	0.374169 [0.549]	2.15324 [0.9928]	1.4157 [0.961]
First_d [prob.]	18.0476 [2.79E-35]***	16.4048 [7.039E-33]***	15.003 [2.512E-30]***
Stable Markets			
Test Statistic [prob.]	0.331647 [0.5658]	0.527901 [0.4884]	0.289652 [0.5815]
First_d [Prob.]	29.5504 [2.334E-34]***	26.3192 [4.96E-39]***	29.5808 [2.657E-34]***
Falling Markets			
Test Statistic [Prob.]	2.32665 [0.9956]	-1.62799 [0.7822]	-1.85578 [0.6773]
First_d [Prob.]	-14.8778 [1.765E-22]***	-7.06138 [2.26E-10]***	17.7613 [4.439E-23]***

*Table 1: Unit Root test (authors compilation) [*** Reject of H_0 at 1%]*

Table 1 shows a clear indication of unit roots present in the original values; however the first differences are stationary (without unit root) at a 1% significance level. Therefore the data has become integrated of order one *I (1)*.

3.2 JOHANSEN COINTEGRATION TEST

The order of integration of the series has been determined. The Johansen test confirms the existence of either no cointegrating vectors (H_0) or one cointegrating vector (H_1).

While the variables are individually integrated at order one, *I (1),* the combined series level of integration could become zero, I (0). Before testing for cointegration the maximum lag length must be determined. The Akaike information criterion and Schwarz Bayesian criterion tests were used to test this, which abbreviated as (AIC) and (BIC) respectively.

Paired Series	***Null Hypothesis***	***Eigen value***	***Trace Statistic (Prob.)***	***Max-Eigen Statistic (Prob.)***
Rising Markets				
USD BRE (Lag1)	r=0	0.0246	8.0457 [0.4678]	6.9937 [0.4984]
	r≤1	0.0037	1.0519 [0.3051]	1.0519 [0.3051]
USD WTI (Lag1)	r=0	0.0198	5.7309 [0.7289]	5.6236 [0.6660]
	r≤1	0.0004	0.1073 [0.7433]	0.1073 [0.7433]
Stable Markets				
USD BRE (Lag1)	r=0***	0.0192	18.465 [0.0158]	15.240 [0.0328]
	r≤1	0.0041	3.2257 [0.0725]	3.2257 [0.0725]
USD WTI (Lag1)	r=0***	0.0152 43	16.099 [0.0389]	12.088 [0.1074]
	r≤1	0.0041	4.0104 [0.0452]	4.0104 [0.0452]
Falling Markets				
USD BRE (Lag1)	r=0	0.0467 41	7.8381 [0.4901]	7.7069 [0.4180]
	r≤1	0.0008	0.1311 [0.7173]	0.1311 [0.7173]
USD WTI (Lag1)	r=0	0.0440 91	7.3217 [0.5527]	7.2598 [0.4676]
	r≤1	0.0004	0.0619 [0.8035]	0.0619 [0.8035]

*Table 2: Johansen cointegration vector test (Authors' compilation) [*** Reject of H_0 at 1%]*
Critical Values based on MacKinnon (1996)

The Johansen cointegration analyses the long run relationships between the paired variables for each category: *USDBRE* and *USDWTI* for each category. The hypothesis is:

H_0: The data series is not cointegrated (no co-integrating vectors)
H_1: The data series is cointegrated (one cointegrated vector)

Thus, the results of both the Max-Eigen statistic and Trace statistics confirm co-integrating equation amongst *USDBRE* and *USDWTI* at 1% significance in the stable markets. Therefore it can be said that there is a long-run relationship between *USDBRE* and *USDWTI* in stable markets.

3.3 PAIR GRANGER-CAUSALITY TEST

A. RISING OIL MARKETS

Granger causality tests are conducted in rising markets using an F test on the first differences for 1-5 lag periods, using a vector auto regressive model (VAR) as the pairs were not cointegrated in the above Johansen test.

Rising Market				
Lag_1 F_stat [Prob.]	Lag_2 F_stat [Prob.]	Lag_3 F_stat [Prob.]	Lag_4 F_stat [Prob.]	Lag_5 F_stat [Prob.]
H_0: Changes in USD does not Granger cause changes BRE				
1.598 [0.2073]	1.4903 [0.2271]	1.0076 [0.3898]	0.9027 [0.4628]	0.9811 [0.4297]
H_0: Changes in BRE does not Granger cause changes USD				
3.3889 [0.0667]*	1.9154 [0.1492]	1.9167 [0.1271]	1.6736 [0.1564]	1.5075 [0.1877]
H_0: Changes in USD does not Granger cause changes WTI				
0.3993 [0.5280]	0.3222 [0.7248]	0.2022 [0.8948]	0.2041 [0.9360]	0.1792[0.9703]
H_0: Changes in WTI does not Granger cause changes USD				
3.7506 [0.0538]*	2.1401 [0.1196]	1.5907 [0.1919]	1.4103 [0.2308]	1.1133 [0.3536]

Table 3: Granger Causality VAR Model (Authors' compilation) [Reject of H_0 at 10%]*
Critical Values from Gretl

From table 3 we can see that in a rising market, the null hypothesis '*Changes in BRE & WTI does not Granger cause changes USD'* has been rejected at 10% significance level. We can therefore accept the alternative that '*Changes in BRE & WTI prices does Granger cause changes USD'* at a 10% significance level for a lagged period of 1 day (short term relationship).

B. STABLE MARKETS

To test the Granger causality of stable markets, the author has used an ECM model. The result shows that for both variations of crude oil, the null hypothesis '*Changes in USD does not Granger cause changes BRE/WTI'* which is rejected at a 1% significance level. Therefore in the case of a stable market, *Changes in USD does Granger cause changes BRE and WTI*.

Stable Market				
Lag_1 (ECM)	Lag_2 (ECM)	Lag_3 (ECM)	Lag_4 (ECM)	Lag_5 (ECM)
H_0: Changes in USD does not Granger cause changes BRE				
9.76e-05 ***	4.00e-05 ***	9.70e-05 ***	9.81e-05 ***	8.66e-05 ***
H_0: Changes in BRE does not Granger cause changes USD				
0.342	0.4757	0.4107	0.4075	0.4813
H_0: Changes in USD does not Granger cause changes WTI				
0.0018 ***	0.0033 ***	0.0020 ***	0.0028 ***	0.0034 ***
H_0: Changes in WTI does not Granger cause changes USD				
0.5468	0.3884	0.459	0.4587	0.3742

*Table 4: Granger Causality ECM model (Authors' compilation) [*** Reject of H_0 at 1%]*
Critical Values from Gretl

Table 4 shows us that *USD* Granger causes *WTI* and *BRE* prices. Changes in *USD* have both an immediate and long-term effect on *WTI* and *BRE*. When (USD_{t-1} - δOP_{t-1}) = 0, both variables are in their equilibrium state.

The model below expresses this:

$$\Delta OP_t = \alpha_1 + \beta_1 \Delta USD_{t-1} + \sigma_1 OP_{t-1} - \delta USD_{t-1} + e_{1t} \quad (4)$$

$$\Delta WTI_t = 2.39 - 0.28\Delta USD_{t-1} - 0.056 OP_{t-1} - 32.74 USD_{t-1} + e_{1t} \quad (5)$$

$$\Delta BRE_t = 4.74 - 1.16\Delta USD_{t-1} + 0.066 BRE_{t-1} - 27.16 USD_{t-1} + e_{1t} \quad (6)$$

Equation 5 and 6 show an increase in *USD* will cause deviations from this equilibrium, causing *WTI* and *BRE* to be too low. Both contracts will then increase to correct the disequilibrium, with the remaining deviations of 5.6% for *WTI* and 6.6% for *BRE* to be corrected in subsequent time periods. An increase in the U.S. dollar exchange rate of one dollar will reduce *WTI* by $0.28 dollars and *BRE* by $1.16. Both models also show that a 1% increase in USD_t/USD_{t-1} will lead to a 32.74% fall in WTI and a 27.16% fall in BRE in the short run at a 1% significance level. It is important to note a typical change in USD_t/USD_{t-1} is approximately 0.003% in this dataset therefore a more accurate corresponding fall in *WTI* is 0.098% and *BRE* 0.082%.

C. FALLING MARKETS

A vector auto regression model is used to look at the relationship between oil prices and U.S. dollar exchange rates. For a 1-day lag, the hypothesis '*Changes in USD does not Granger cause changes BRE'* was rejected at 1% significance level; therefore the alternative hypothesis is accepted that *Changes in USD does Granger cause changes in BRE.*

There after we start to see a bi-directional relationship between *BRE* and U.S. dollar exchange rate in the short term at a 10% significance level. For this data set there appears to be some disconnect between *WTI* and *USD* prices in the recent oil price falls.

Falling Market				
Lag_1 F_stat [Prob.]	Lag_2 F_stat [Prob.]	Lag_3 F_stat [Prob.]	Lag_4 F_stat [Prob.]	Lag_5 F_stat [Prob.]
H_0: Changes in USD does not Granger cause changes BRE				
7.5890 [0.0066] ***	3.0381 [0.0508]*	2.1651 [0.0945] *	2.0830 [0.0859] *	1.7770 [0.1211]
H_0: Changes in BRE does not Granger cause changes USD				
2.3247 [0.1294]	2.5066 [0.0849]*	2.6103 [0.0536] *	2.5109 [0.0443] **	2.0545 [0.0745] *
H_0: Changes in USD does not Granger cause changes WTI				
0.0058284 [0.9392]	0.0067482 [0.9933]	0.056114 [0.9825]	0.91554 [0.4566]	0.72717 [0.6041]
H_0: Changes in WTI does not Granger cause changes USD				
1.1104 [0.2936]	0.78072 [0.4599]	1.3475 [0.2612]	0.91491 [0.4570]	0.74148 [0.5936]

Table 4: Granger Causality VAR test (Authors' compilation)
[Reject of H_0 at 10%, ** Reject of H_0 at 5% and *** Reject of H_0 at 1%]*
Critical Values from Gretl

4. DISCUSSION ON RESULTS

A. RISING OIL MARKETS

The results show that for the period of rising oil markets, we found no cointegration between oil prices and U.S. dollar exchange rates, therefore no long run relationship exists between the two series. The Granger causality test found that there is a causal link between both variations of crude and the dollar value at a 10% significance level. Therefore in rising markets oil prices 'Granger cause' U.S. dollar value in the short term. Which is consistent with Basher el al. (2012) finds that oil price shocks tend to depress U.S. dollar exchange rates in the short run. Also Reboredo and Rivera_castro (2013) used a wavelet approach and found that oil prices led exchange rates at negative dependence in crisis period. One of the main reasons for an oil shock in this period was the Arab spring, which officially started on 18 December 2010. The Brent crude oil price on the 17 December 2010 was $92.32 and rose to a peak of $127.29 on the 11 April 2011. In approximately 3 months, Brent crude oil prices rose by approximately 28%. Figure 2 also highlights the divergence between BRE and WTI prices, due to a supply glut in WTI crude at the time.

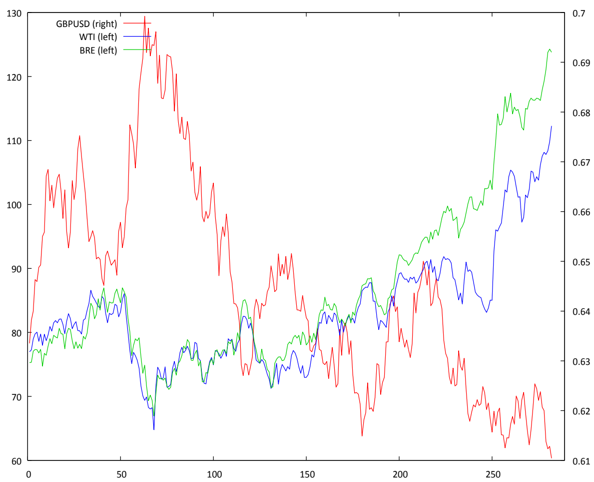


Figure 2 (authors compilation)

B. STABLE MARKETS

In the stable oil market data sample, we can see in figure 3 the divergence between Brent crude oil and WTI prices persist. The Johansen cointegration test shows us that there is a long run relationship between oil prices and U.S. dollar exchange rate. We examine this relationship further using an error correction model to test Granger causality and the short-term relationship between the two series. The tests indicated that changes in the U.S. dollar Granger cause changes in oil prices at a 1% significance level. These results are consistent with Brahmasrene, Huang and Sissoko (2014) who found that in the short run exchanges rates Granger cause crude oil prices and Uddin et al. (2013) found that exchange rate changes affect oil price in the short run.

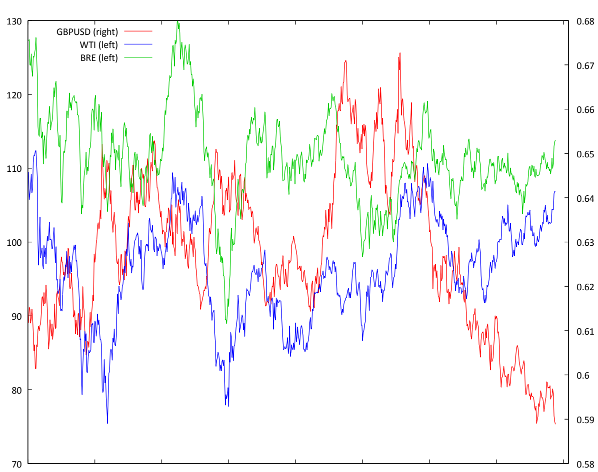


Figure 3 (authors compilation)

C. FALLING MARKETS

The Johansen cointegration test indicates no cointegration vectors amongst the paired variables in falling markets. The Granger causality test shows that a change in U.S. dollar exchange rate Granger causes changes in Brent oil price at a 1-day lag. There then appears to be a bi-directional relationship between Brent and U.S. dollar exchange rates in the short term. Whereas U.S. dollar and WTI have no long term or short-term relationship in this data set of falling oil prices. The results for Brent show that of Uddin et al. (2013) who found that exchange rate changes affect oil price in the short run and Brahmasrene, Huang and Sissoko (2014) finds that in the short run exchange rates Granger cause crude oil prices. The market in this sample fell from $115.59 on 19 June 2014 to $46.92 on the 30 January 2015, which is 59.40% drop in approximately 8 months. This steep fall has been attributed to a supply glut in the markets and OPEC's policy of not reducing supply as they normally would. The motivation behind OPEC's policy is to keep prices low in order to mitigate competition from non-OPEC oil suppliers who have been competing with OPEC for market share in recent years.

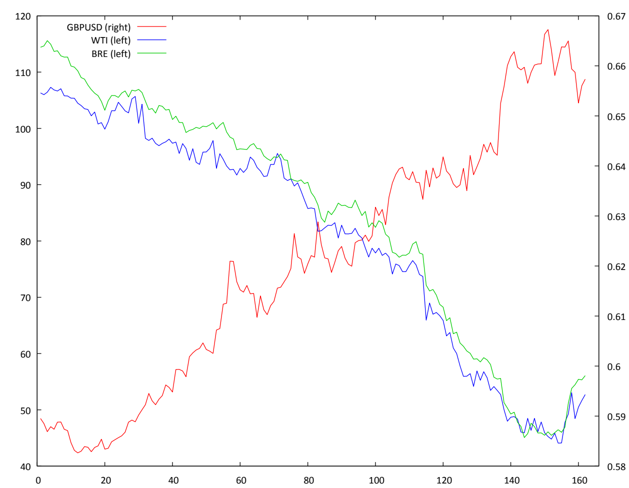


Figure 4 (authors compilation)

5. CONCLUSIONS

This paper set out to explore the relationship between benchmark crude oil prices and the U.S. dollar exchange rates in periods of rising, stable and falling oil prices. Overall the empirical analysis and econometric testing show that in rising and falling oil markets, oil prices and U.S. dollar exchange rates disconnect in the long run however the results somewhat differ in the short run. In the short term in rising oil markets oil prices Granger cause US exchange rates. In falling oil markets, U.S. dollar prices Granger caused Brent oil prices but not West Texas Intermediary on a one day lag length, however thereafter in the short term there appeared to be a bi-directional relationship between U.S. dollar and Brent prices. The results also found that stable markets indicated a long-term relationship between oil prices and U.S. dollar exchange rates and a short-term relationship where U.S. dollar exchange rates Granger caused changes in oil prices.

Oil market participants and policy makers should be aware of the strength and characteristics of the relationship between oil prices and the U.S. dollar exchange rate. Particularly when making decisions that may impact the U.S. dollar or oil prices. The Federal Reserve in particular often considers implementing policies such as quantitative easing during an economic recession with an aim to boost the economy. This may have a counterproductive effect. If quantitative easing reduces the value of the dollar in a stable oil market, according the findings of this study oil prices will start to increase, which can raise energy prices and limit economic activity.

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